

REMARKS

Reconsideration is respectfully requested. Claims 1-23 are present in the application. Claims 8-23 are withdrawn, as directed to non-elected invention. Claim 1 is amended herein.

Claims 1 and 5-7 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sugahara (JP 09-007591) in view of Hayashida (US 2001/0041292) and Katou (JP 2003-309327). Applicants respectfully traverse.

Claims 2-4 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Sugahara (JP 09-007591) in view of Hayashida (US 2001/0041292) and Katou (JP 2003-309327) and further in view of Okada (JP 2002-256301). Applicants respectfully traverse.

I. Features of the Present Claims as Amended

(1) The present claim 1 is amended to read as follows.

1. (currently amended) A sealed type nickel-metal hydride battery, comprising a positive electrode comprising an active material composed mainly of nickel hydroxide, a negative electrode comprising a hydrogen storing alloy particle composed mainly of a rare earth element, nickel and a transition metal element that absorb and desorb hydrogen, and an electrolyte composed mainly of an aqueous solution of an alkaline metal hydroxide, wherein:

a layer that contains more nickel than a matrix component does and has the thickness of 50 nm and more to 400 nm is located on a surface of said hydrogen storing alloy particle, layers that contain more nickel than a matrix component does are located on a surface of cracks that open at the surface of said hydrogen storing alloy particle, said layers are formed by treatment of said hydrogen storing alloy particle with said cracks with an alkaline aqueous solution,

and, said hydrogen storing alloy particle has a mass saturation magnetization of 2.5 emu/g or greater and contains magnetic nickel in an amount of 0.5 mmol/g or greater.

(2) The present claims as amended (to be referred to as "the present claims" hereinafter) have the following features.

As described in the specification so as to read as "It is here noted that although the thickness of the Ni-rich layers along the cracks in the inventive alloy powder is not mentioned, they were found to be at most twice as large as those on the surfaces of the powder." (specification of the US patent application, page 38, lines 15 to 19), "When the amount of hydrogen absorbed in each of inventive alloys 1 to 5 was 5% or greater as calculated on the gas phase basis of the alloy, it could be found that even with the same magnetic material content, the high-rate discharge capacity of each inventive battery at 5°C is much higher than that of comparative battery 1 having no Ni-rich layer in the alloy." (page 39, lines 6 to 12), "Inventive

battery 7 having a mass saturation magnetization of 2.5 emu/g and a magnetic nickel content of 0.53 mmol/g is much more improved in terms of high-rate discharge capability at 5°C and 7 ItA, although a discharge capacity of barely about 10% is obtained at 5°C and 10 ItA. . . . Consequently, it is understood that the mass saturation magnetization and the magnetic nickel content are preferably 2.5 emu/g or greater and 0.5 mmol/g or greater, . . . respectively." (page 46, lines 3 to 15)

The present claims provide an effect of remarkably improving the "high-rate discharge capacity at 5°C" by satisfying two requirements including (1) "layers that contain more nickel than a matrix component does (Ni-rich layers) are located on a surface of cracks that open at the surface of said hydrogen storing alloy particle, said layers are formed by treatment of said hydrogen storing alloy particle with said cracks with an alkaline aqueous solution" and (2) "the mass saturation magnetization and the magnetic nickel content in said hydrogen storing alloy particle are 2.5 emu/g or greater and 0.5 mmol/g or greater.

II. Comparison with and Examination of Sugahara (JP 09-007591), Hayashida (US 2001/0041292), Katou (JP 2002-309327) and Okada (JP 2002-256301)

When the present claims and Sugahara's teaching (in view of Hayashida) are compared with each other, they agree with each other in that "A sealed type nickel-metal hydride battery, comprising a positive electrode comprising an active material

composed mainly of nickel hydride, a negative electrode comprising a hydrogen storing alloy particle composed mainly of a rare earth element, nickel and a transition metal element that absorb and desorb hydrogen, and an electrolyte composed mainly of an aqueous solution of an alkaline metal hydroxide, wherein; a layer that contains more nickel than a matrix component does and has the thickness of 50 nm and more to 200 nm is located on a surface of said hydrogen storing alloy particle." But differ from each other at the following points.

(1) According to the present claims, there are "layers that contain more nickel than a matrix component does are located on a surface of cracks that open at the surface of said hydrogen storing alloy particle" and the layers are formed by treating the hydrogen storing alloy particle having "cracks" with an alkaline aqueous solution, whereas, according to the Sugahara's disclosure, the hydrogen storing alloy particle does not have such "cracks" as described above and "the hydrogen storing alloy particle with cracks formed" are not treated.

(2) According to the present claims, "said hydrogen storing alloy particle has a mass saturation magnetization of 2.5 emu/g or greater and contains magnetic nickel in an amount of 0.5 mmol/g or greater", whereas Sugahara's disclosure is unclear in terms of "a mass saturation magnetization" and "an amount of magnetic nickel".

Note that Hayashida only describes the configuration of a sealed type nickel-metal hydride battery and does not describe anything about a hydrogen storing alloy particle having "a layer that contains more nickel than a matrix component does and has the thickness of 50 nm and more to 400 nm".

Sugahara's teaching corresponds to Comparative Example 1 described in the specification of the present application. A hydrogen storing alloy particle of Comparative Example 1 "having no Ni-rich layer in the alloy" as described above and, when a hydrogen storing alloy particle in Examples 1 through 5 of the present application and a hydrogen storing alloy particle of Comparative Example 1 are compared for "high-rate discharge capability at 5°C", any of the batteries of Examples 1 through 5 having Ni-rich layers along the cracks in the hydrogen storing alloy particle shows a discharge capacity at 10 ItA of not less than 80%, whereas the battery of Comparative Example 1 shows a discharge capacity at 10 ItA of 4% and the high-rate discharge capacity at 5°C thereof is very low if the thickness of the Ni-rich layer formed on the surface of a hydrogen storing alloy particle is substantially the same as that of the counterpart in any of Examples 1 through 5. Therefore, when Sugahara's teaching is compared with the present claims, it will be found that the former shows a very low "high-rate discharge capacity at 5°C".

According to Okada's teaching, while a hydrogen storing alloy particle is obtained by immersing starting material powder

in an NaOH aqueous solution at 90°C or above for a duration substantially the same as the duration of the present claims, the hydrogen storing alloy particle does not have "cracks" and hence it has nothing to do with "a hydrogen storing alloy particle with cracks formed" that is treated in an NaOH aqueous solution at 90° or above. Therefore, if a hydrogen storing alloy particle showing a mass saturation magnetization and an amount of magnetic nickel that are substantially the same as those of the present disclosure is obtained, it simply corresponds to Comparative Example 1 described in the specification of the present application (a mass saturation magnetization is 5 emu/g which is the same as that of any of Examples 1 through 5) so that, when compared with the present application, "the high-rate discharge capacity at 5°C" thereof is very low as in the case of Sugahara's teaching.

Meanwhile, Katou describes providing "a hydrogen occluding alloy particle for electrodes, characterized in that cracks are formed on the surface of the hydrogen occluding alloy particle and coat layers containing nickel are formed on the surface of the hydrogen occluding alloy particle and in the inside of the cracks" (Claim 1) and "a method of manufacturing a hydrogen occluding alloy particle for electrodes according to any of claims 1 through 6, characterized by comprising a step of forming cracks on the surface of the hydrogen occluding alloy particle by hydrogenation and a step of forming coat layers containing nickel

on the surface of the hydrogen occluding alloy particle and in the inside of the cracks by electroless plating" (Claim 7). However it does not suggest at all adopting means by which "Ni-rich layers are formed by treatment of said hydrogen storing alloy particle with said cracks with an alkaline aqueous solution" after forming cracks on the surface of a hydrogen storing alloy particle, which a feature that the present claims have.

According to the present application, cracks are formed on the surface of the hydrogen storing alloy particle, which is subsequently treated with "an alkaline aqueous solution" for a predetermined period of time or more so that "layers that contain more nickel than a matrix component does are located on a surface of cracks". Then, as a result, "said hydrogen storing alloy particle has a mass saturation magnetization of 2.5 emu/g or greater and contains magnetic nickel in an amount of 0.5 mmol/g or greater" as shown in Table 4 of the specification of the present application so that the discharge capacity at 7 ItA becomes not less than 78%. The "layers" that are formed by the above described means has a composition that can occlude hydrogen and, since hydrogen atoms can move in the inside thereof, they operate as excellent moving path to consequently improve the "high-rate discharge capacity at 5°C".

To the contrary, according to Katou, cracks are formed on the surface of a hydrogen storing alloy particle for the purpose

of improving the cycle life performance and subsequently coat layers containing nickel are formed on the surface of the hydrogen storing alloy particle and in the inside of the cracks by electroless plating. Coat layers containing nickel that are formed by electroless plating can hardly operate as moving path of hydrogen atoms so that the high-rate discharge capacity is not improved if the cycle life performance is improved.

As shown in Table 4 for Example 6 (which is turned to Comparative Example by the current amendments) in the specification of the present application, while the cycle life performance is improved even when the mass saturation magnetization is less than 2.5 emu/g and the amount of magnetic nickel is less than 0.5 mmol/g, the discharge capacity at 7 ItA is 10% and the high-rate discharge capacity is not improved. Thus, there may be cases where the cycle life performance is improved but the high-rate discharge capacity is not improved by treating a hydrogen storing alloy particle. Therefore, if an improvement of cycle life performance can be predicted from Katou, it does not necessarily means that an improvement of high-rate discharge capacity can be predicted from Katou's teaching.

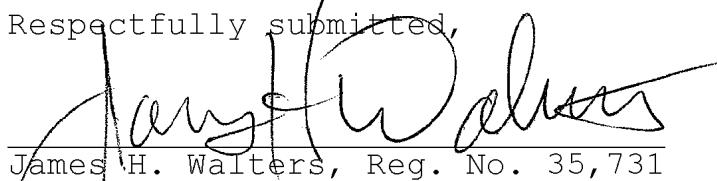
Thus, one having ordinary skill in the art cannot easily get to an idea of forming cracks on the surface of a hydrogen storing alloy particle and subsequently forming layers by treating said hydrogen storing alloy particle with said cracks with an alkaline aqueous solution such that the "layers that contain more nickel

than a matrix component does are located on a surface of cracks" in order to realize "a mass saturation magnetization of 2.5 emu/g or greater" and "magnetic nickel in an amount of 0.5 mmol/g or greater" for the purpose of improving "high-rate discharge capacity" by combining Sugahara's teaching (in view of Hayashida) with Katou's teaching and Okada's teaching.

As has been described above, the present claims are not obvious from the teachings of Sugahara, Hayashida, Katou and Okada, whether considered alone or when combined.

In light of the above noted amendments and remarks, this application is believed in condition for allowance and notice thereof is respectfully solicited. The Examiner is asked to contact applicant's attorney at 503-224-0115 if there are any questions.

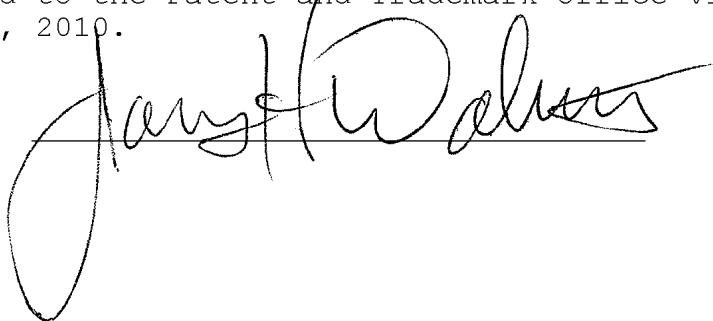
It is believed that no further fees are due with this filing or that the required fees are being submitted herewith. However, if additional fees are required to keep the application pending, please charge deposit account 503036. If fee refund is owed, please refund to deposit account 503036.

Respectfully submitted,  
  
James H. Walters, Reg. No. 35,731

Customer number 802  
patenttm.us  
P.O. Box 82788  
Portland, Oregon 97282-0788 US  
(503) 224-0115  
DOCKET: T-1470

Certification of Electronic Transmission

I hereby certify that this correspondence is being electronically transmitted to the Patent and Trademark Office via the EFS system on this May 19, 2010.

A handwritten signature in black ink, appearing to read "Jany H. Walker", is written over a horizontal line. The signature is fluid and cursive, with a large, stylized 'J' at the beginning.